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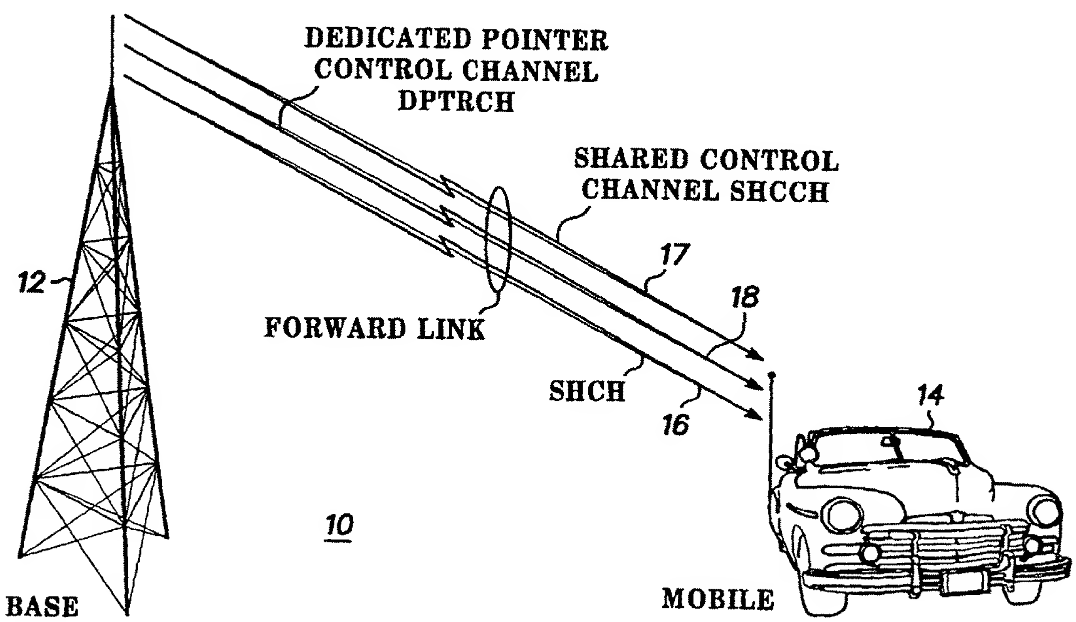
(54) Title: APPARATUS AND METHOD FOR PROVIDING SEPARATE FORWARD DEDICATED AND SHARED CONTROL CHANNELS IN A COMMUNICATIONS SYSTEM



(57) **Abstract:** Separate forward dedicated and shared control channels (17, 18) are provided in a spread-spectrum communication. The forward dedicated control channel (18) is used to communicate persistent control information and point to the shared control channel (17) when further intermittent control information concerning transmission of data to a mobile station (14) needs to be communicated. The use of a dedicated control channel for only necessary persistent control information, while only pointing to a shared control channel when it is needed, affords more efficient utilization of system resources.

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APPARATUS AND METHOD FOR PROVIDING SEPARATE FORWARD DEDICATED AND SHARED CONTROL CHANNELS IN A COMMUNICATIONS SYSTEM

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Application No. 60/197,588, filed April 17, 2000.

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and method for providing separate dedicated and shared control channels in a communications system and, more particularly, in a forward link of a Code Division Multiple Access (CDMA) communication system.

Typically in communication systems such as CDMA and, more particularly, CDMA evolutions such as WCDMA, dedicated channels are required for sending data and also for control of the system. Within the forward link of such systems, a single channel is used to carry the information to be transmitted and characteristics of the transmitted information are conveyed on another separate forward control channel. Each of these channels occupies a Walsh code from a finite set of available Walsh codes. To keep the system from becoming Walsh code limited it is important to conserve Walsh code resources. The allocation of these dedicated channels for each user typically requires rapid shuffling between dormant and active states to free up Walsh code resources. Problems that arise from this rapid shuffling include too few bits available, too few users, too much power, too much reverse link automatic repeat request (ARQ), latency, or too much reliance on using a data channel such as a shared channel (SHCH 16) for layer 3 information (e.g., switching of mobile stations between active and hold states) and ARQ. The shared channel SHCH 16 is the forward channel used to send data packets to users in the active state and can reach very high peak data rates by using over 80% of the available Walsh code resources. However, the Walsh code resources are limited in the conventional systems because of the relatively small spreading factor sizes required to support the required payload and coding bits sent on the SHCH 16.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In order to better use the Walsh Code resource efficiently, it is possible to separate control and layer 3 information into data that is required to be sent in every frame interval whether or not a mobile user is scheduled to receive data over a data channel such as the shared channel (SHCH 16) and additional data that only needs to be sent when the SHCH 16 is scheduled for that user or when layer 3 information needs to be sent. Hence, it is more efficient to provide a set of dedicated control channels for the data that is always required to be sent and a smaller set of shared control channels for the additional data, which is sent less frequently.

According to this scheme of separating information into different channels, the dedicated control channel is always transmitted to a given user that is not in a dormant state. The shared dedicated channel is allocated to a given user if it is to receive data over a data channel such as the SHCH 16 and needs information to properly decode and use it or layer 3 information needs to be sent and hence, in either case, more bits are needed. Typically, only a small number of users (e.g., <3) will be simultaneously scheduled for a given frame interval or will need layer 3 information, hence, a smaller number of shared control channels are required compared to the dedicated control channels. Dedicated control channels will be referred to as dedicated pointer channels (DPTRCH 18) in this description.

Hence, the present invention is directed to a method and apparatus that provide a separate pointer channel and shared control channel instead of a single control channel as employed in the conventional systems. Thus, a statistical approach can be taken that allows control information and other information that is requisitely persistent to be transmitted via a dedicated control channel while other information that is intermittent may be transmitted in shared channel resources. This statistical splitting of control information into multiple channels affords more economical use of Walsh code resources and sufficient bits at lower power levels without over reliance on the shared channel SHCH 16. The dedicated pointer control channel DPTRCH 18 is used to continuously communicate information including whether or not a mobile unit in a forward link portion of a spread spectrum communication system has need to receive information concerning a data channel such as a shared channel SHCH 16 that is accessed via the

length shown in field 30 contained within the reserved link control field 24. The reserved link control field 24 may also contain reverse link scheduling information (not shown). Further information may include a hybrid automatic repeat request HARQ shown in field 32 of the reserve link control 24. In an alternate embodiment, the reserved link control field 24 may contain the starting Walsh code, the modulation coding scheme (MCS) and ARQ information.

The dedicated pointer control channel frame 20 also contains cyclic redundancy check CRC information for forward error correction shown in field 26 of the frame 20. Additionally, the frame contains power control bit information 27 to regulate the reverse link power for a CDMA system and a tail 28 to mark the end of the frame.

According to a preferred embodiment, the dedicated pointer control channel frame 20 is typically 5 milliseconds long. However, the time length of the frame is not limited to this amount, but could be modified to whatever particular communication system the frame is being used. Similarly, the fields and width in bits may also be modified in the dedicated pointer control channel frame 20.

Figure 3 illustrates a dedicated pointer control channel DPTRCH frame 34 in a "null" format or, in other words, when informat ion is not required to be transmitted on a corresponding shared control channel SHCCH 17. Similar to the assignment format 20, the null frame 34 contains a pointer field 35, a CRC field 37, a power control bit field 38 and a tail 39. Different from the assignment format, the null frame format merely transmits a reserved field 36 containing reverse link scheduling information for the reverse link in a CDMA system.

Figure 4 illustrates a shared control channel SHCCH frame shown generally at 40. The shared control channel frame 40 includes an assignment field 42 having various aperiodic or intermittent information such as information required for demodulation of the shared channel SHCH 16 or as a transport for automatic repeat request ARQ feedback in layer 3 signaling information. The assignment field 42 of the shared control channel frame 40 is shown to include fields 48-50, which may include a field 48 for indicating the particular modulating coding scheme MCS that is used in the forward shared channel SHCH 16, a starting Walsh code 49 and gain information 50. Similar to the dedicated pointer control frame, the shared control channel frame 40 also includes a

whether the mobile is in the active or control hold state (an active state being when data is transmitted to be received by the mobile and the control hold state being when no data is transmitted to the mobile). The multiplexed data B_{DPTR} output from the multiplexer 70 is then multiplied by a multiplier 72 with a Walsh code w_n and output for transmission at particular chip rate R_c. Preferably, the chip rate is equal to 1.2288 million chips per second (Mcps) according to the IS95 standard or 3.84 Mcps according to WCDMA.

Additionally, a switching element (not shown) or some other equivalent means to prevent the control data B from being transmitted may be utilized as will be appreciated by one of ordinary skill in the art. The control data B is prevented from being transmitted in those instances where a mobile is in a control hold state and no data via the shared channel SHCH 16 is to be transmitted to the mobile 14 within the time frame of the dedicated pointer control channel frame. Hence, a "null" frame will be generated with only the requisite power control bit information.

A shared control channel generator 62 contains similar elements as the dedicated pointer control channel generator 60, including a convolutional encoder 74 and interleaver 76 and an M-ary modulator 78. However, the shared channel control generator 62 does not require a multiplexer since the power control bit information is sent only via the dedicated pointer control channel DPTRCH 18. Thus the modulated control data B_{SCH} from the modulator 78 is multiplied by multiplier 80 by Walsh codes w_n for transmission on the forward link. Of course, if a mobile unit to which control data is sent is in the control hold state no control data B_{SCH} will be transmitted via the shared controlled channel generator 62.

As stated previously, utilization of a dedicated pointer channel DPTRCH 18 transmitting only essential persistent control information and pointing to intermittent control information carried on the shared control channel SHCCH 17 only when the intermittent control information has needs to be sent affords more efficient allocation of system resources in a spread spectrum communication system. Additionally, it will be appreciated by those skilled in the art that the present method and apparatus may be utilized in other communication systems that transmit overhead information such as control information in order to efficiently allocate resources.

What is claimed is:

1. A method for providing control information in a communication system comprising the steps of:

providing a first control channel communicating a first set of control information to at least one component within the communication system; and

providing a second control channel selectively communicating a second set of control information to the at least one component within the communication system based on the first set of control information.

2. The method according to claim 1, further comprising:

transmitting data on a data channel to the at least one component; and

wherein the first set of control information includes an indicator value that is used by the communication system to indicate that the second set of control information on the second control channel is transmitted to the at least one component, to identify the second control channel and to indicate that data on the data channel is transmitted to the at least one component.

3. The method according to claim 2, wherein the second control channel is a shared control channel selected from a plurality of pooled shared control channels based on the indicator value.

4. The method according to claim 1, wherein the first set of control information includes an indicator value that is used by the communication system to indicate that the second set of control information on the second control channel is not transmitted to the at least one component.

5. An apparatus for providing control information in a communication system comprising:

a first control channel transmitter configured for transmitting a first set of control information to at least one component within the communication system; and

10. The apparatus of claim 5, wherein the second control transmitter is comprised of an input configured to receive control data; an encoder connected to the input for encoding control data, an interleaver for interleaving the encoded control data; a modulator for modulating the interleaved encoded control data according to a prescribed modulation scheme and outputting modulated control data; and a multiplier for multiplying a Walsh number with the modulated control data.

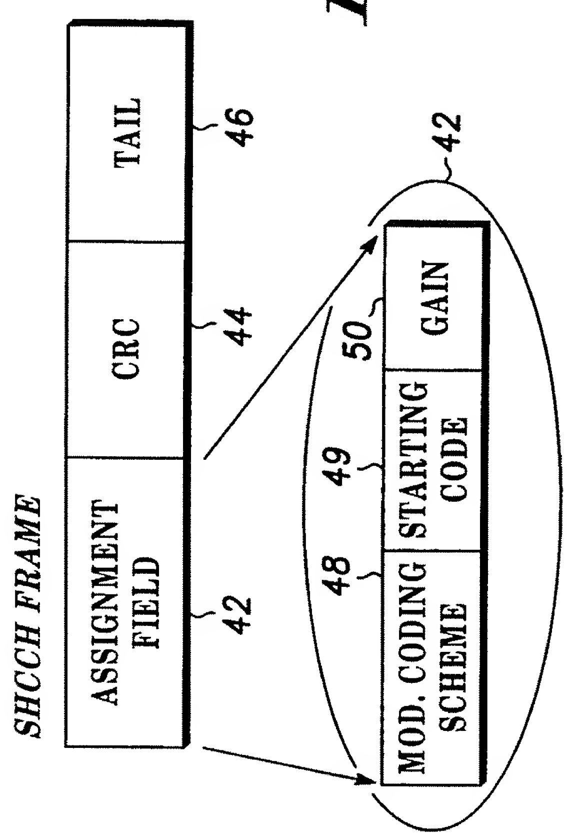
SHCCH FRAME
ASSIGNMENT FIELD
42
CRC
44
TAIL
46
MOD. CODING SCHEME
48
STARTING CODE
49
GAIN
50
42

FIG. 4

40

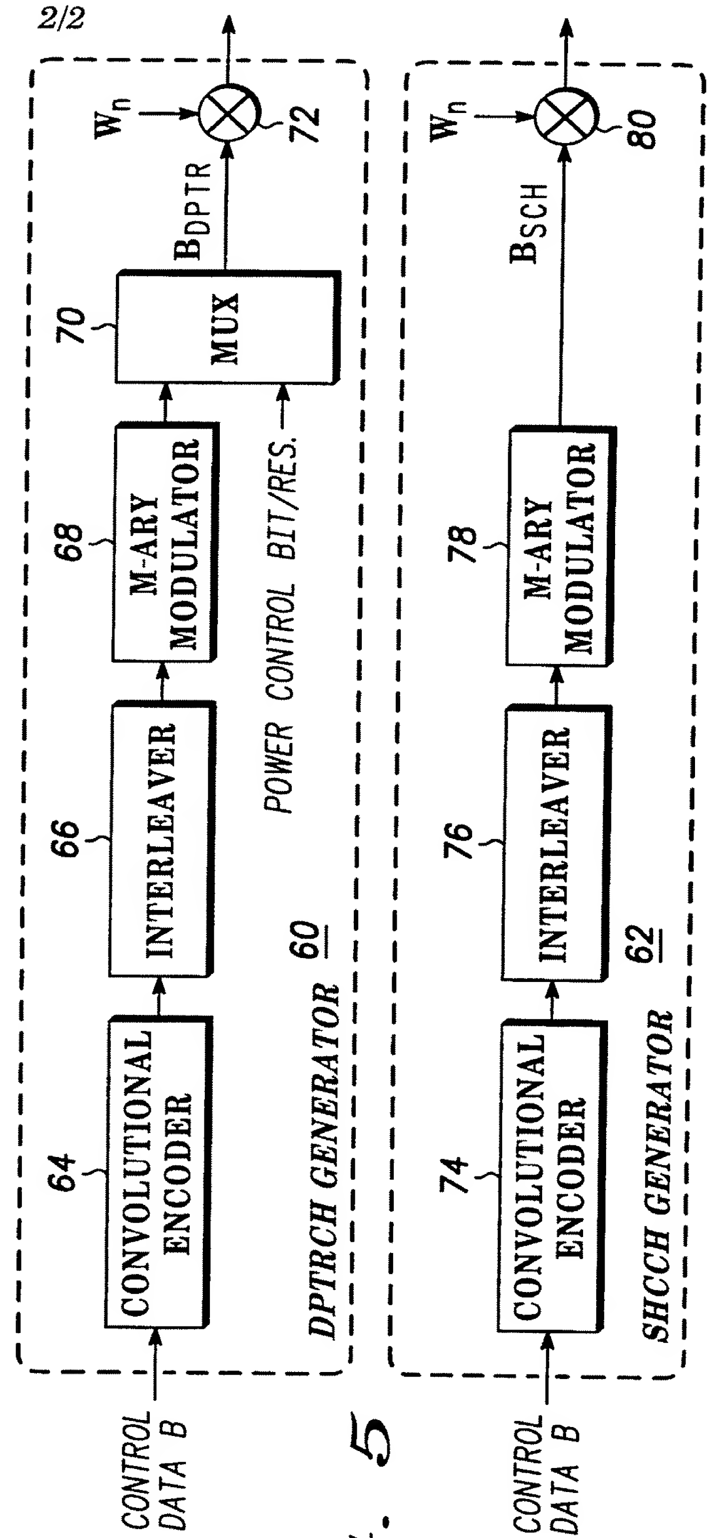
CONTROL DATA B
64
CONVOLUTIONAL ENCODER
66
INTERLEAVER
68
M-ARY MODULATOR
70
MUX
POWER CONTROL BIT/RES.
B DPTR
W n
72
DPTRCH GENERATOR
60
CONTROL DATA B
74
CONVOLUTIONAL ENCODER
76
INTERLEAVER
78
M-ARY MODULATOR
B SCH
W n
80
SHCCH GENERATOR
62

FIG. 5

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER:
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370/208, 209, 320, 329, 335, 342, 441, 437, 464, 465, 479; 375/130, 145